Claims

1. A method for measuring the properties of a formation traversed by a borehole in which a directional seismic or sonic signal is generated downhole and is propagated into the surrounding formation and an electrokinetic signal generated by the seismic or sonic signal is detected by detecting means and in which the spatial distribution of the outgoing seismic signal is adjusted so that the electrokinetic signals are generated from different zones around the source of the seismic or sonic signal.

2. A method as claimed in claim 1 in which the seismic signal is generated by the generation of a seismic or sonic shock downhole which propagates a seismic signal into the surrounding rock.

3. A method as claimed in claim 1 or 2 in which the direction of the seismic signal is varied in three dimensions azimuthally with respect to source of the seismic shock in the borehole.

4. A method as claimed in any one of claims 1 to 3 in which the direction of the seismic shock is rotated radially about a circle with the source of the seismic shock at the centre of the circle.

5. A method as claimed in claim 3 or 4 in which the direction of the seismic signal is varied mechanically by physically turning the source

6. A method as claimed in claim 5 in which a substantially uni-directional seismic source is rotated so the direction of the seismic signal is rotated and moved so that the direction of the seismic signal moves up and down.

7. A method as claimed in claim 4 in which the seismic signal is propagated omni-directionally and a shield with an aperture is positioned around the source so that the seismic signal propagates through the aperture and the direction of the seismic signal is changed by moving the location of the aperture.

8. A method as claimed in any one of claims 1 to 4 in which the direction of the seismic signal is changed by wave interference or wave interaction of two or more sources acting together to produced a seismic signal which is focussed in a particular direction or location and by varying the frequency, amplitude and/or phases of the sources of the seismic shock the spatial distribution, direction and location of the outgoing seismic signal is changed.

9. A method as claimed in any one of claims 1 to 8 in which the source of the seismic signal is positioned substantially centrally within the borehole and is not in contact with the borehole wall

10. A method as claimed in claims 8 or 9 in which there are two or more separate sources of the seismic shock spaced apart from each other and there are means to vary the amplitude, frequency and/or phase independently and the source of the seismic shock propagates a seismic signal in substantially all directions so that the direction of the combined signal produced can be varied in three dimensions.

11. A method as claimed in claim 10 in which each seismic source continuously emits sound simultaneously on at least two finite frequencies with the resultant oscillation being the sum of the various sinusoidal pressure oscillations and by variation and combination of these signals the direction of the combined signal is varied.

12. A method as claimed in claim 11 in which the amplified electrical signals are demodulated with respect to the source frequencies and the amplitude and phase relative to the source sampled at a frequency of 1-100 Hz per channel and converted from analogue to digital form, of 12 or 16 bit accuracy.

13. A method as claimed in any one of claims 1 to 12 in which the seismic signal is generated whilst the source of the seismic signal is lowered or raised up from the borehole to provide a continuous or semi-continuous measurement of rock along the borehole

14. Apparatus for measuring the properties of rocks surrounding a borehole, which apparatus comprises a casing adapted to be lowered down a bore hole in which casing there is a seismic means for generating seismic signals and a means for varying the direction of the seismic signal and having associated therewith, a means adapted to detect electrical signals generated in the rock surrounding the bore hole by the effect of a seismic shock generated by seismic means.

15. Apparatus as claimed in claim 14 in which the means for generating the seismic signals generates a series of pressure pulses or a continuous pressure oscillation, at one or more finite frequencies.

16. Apparatus as claimed in claim 14 or 15 in which the means for generating the seismic signals is a magnetostrictive or piezoelectric transducer whose signal is controllable electrically.

17. Apparatus as claimed in any one of claims 14 to 16 in which the means for generating a seismic signal comprises a cylindrical chamber having holes in its side, which when downhole will be full of drilling fluid with the sides of the chamber being close to the sides of the borehole, there being a means to transmit a shock or applied force to the fluid in the chamber so as to cause the shock to be transmitted through the fluid in the chamber through the holes into the surrounding rock

18. Apparatus as claimed in any one of claims 14 to 17 in which the electrical receiver consists of one or two pairs of electrodes forming a short dipole antenna with electrically isolated ends or two coils with electrically isolated lines, the ends of which being connected to an amplifier which amplifies the signals whilst keeping them electrically isolated.

19. Apparatus as claimed in any one of claims 14 to 18 in which there are means to physically turn the source to vary the direction of the seismic signal.

20. Apparatus as claimed in claim 14 to 18 in which there is a shield with an aperture positioned around the seismic source which source is adapted to propagate a seismic signal omni-directionally so that the seismic signal propagates through the aperture

and there are means to move the location of the aperture so the direction of the seismic signal is varied.

21. Apparatus as claimed in any one of claims 14 to 18 in which there are two or more sources of seismic signals acting together and means to vary the direction of the seismic signal by wave interference or wave interaction of the two or more sources to produce a seismic signal which is focussed in a particular direction or location and means to vary the frequency, amplitude and/or phases of the sources of the seismic shock to change the spatial distribution, direction and location of the outgoing seismic signal.

22. Apparatus as claimed in any one of claims 14 to 18 in which there are two or more separate sources of the seismic shock spaced apart from each other and there are means to vary the amplitude, frequency and/or phase independently of the seismic shock, the source of the seismic shock being able to propagate a seismic signal in substantially all directions so that the direction of the combined signal produced can be varied in three dimensions.

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A1

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B1